Basewide Energy Systems Plan

Executive Summary

Final Report

Fort Campbell, Kentucky

March 1980

Prepared For
MOBILE DISTRICT CORPS OF ENGINEERS
MOBILE, ALABAMA
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EXECUTIVE SUMMARY

Included in this summary are the results of the Basewide Energy Systems Plan for Fort Campbell, Kentucky. This plan includes an analysis and recommendation of energy conservation projects for the reduction of the installation's present energy consumption. The installation should be aware that the savings figures presented in this summary can only be realized after all projects have been implemented. Black & Veatch has developed projects that would meet funding requirements for the energy conservation program. Furthermore, the recommended projects provide partial compliance with the energy conservation requirement for the installation as outlined in the Army Facilities Energy Plan. This summary presents data on the following:

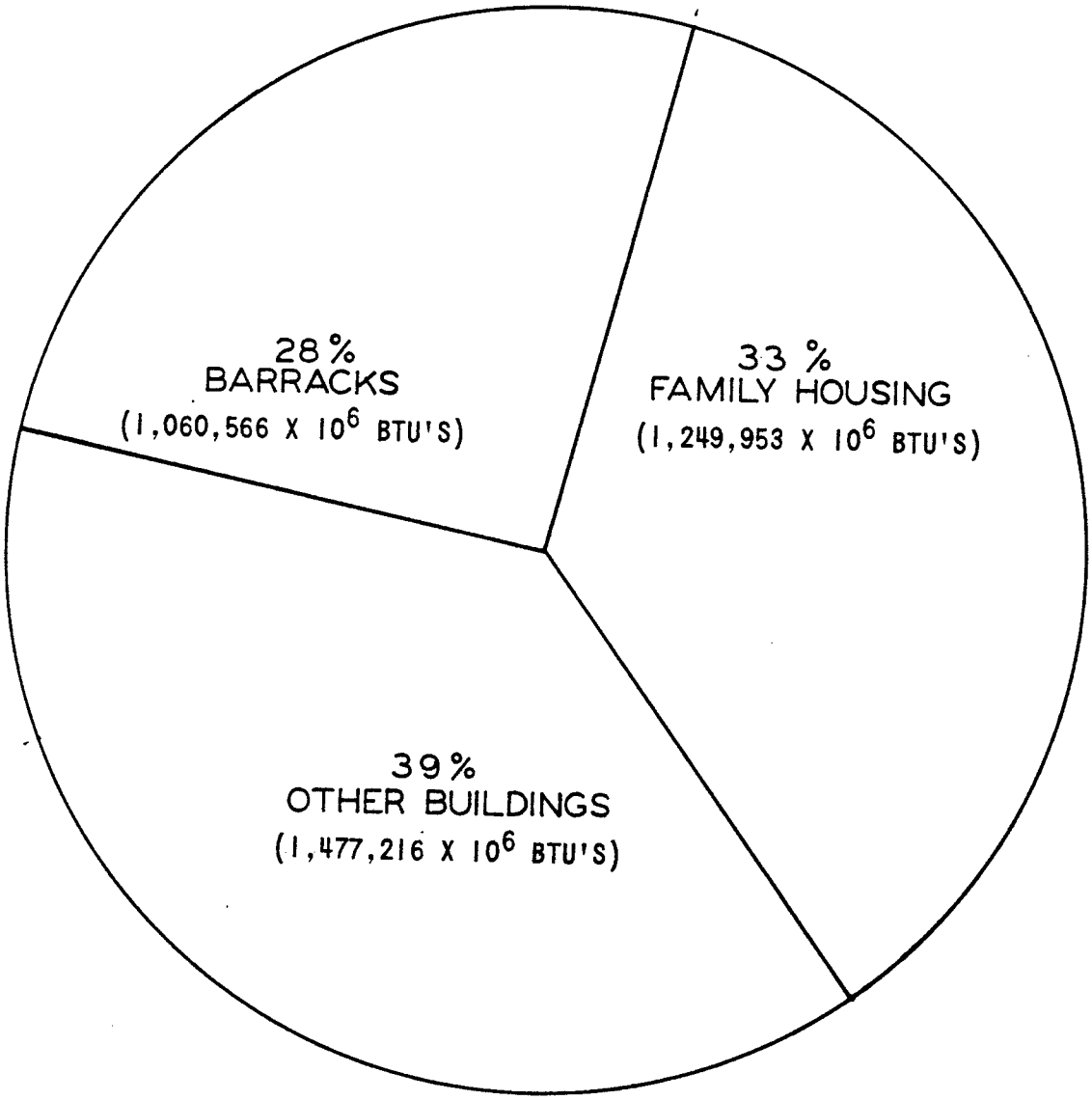
- Existing energy consumption
- Source energy reductions due to energy conservation techniques applied to building systems
- Application of solar energy to reduce fossil fuel consumption
- Savings utilizing central energy monitoring and control systems (EMCS)
- Use of solid waste as an alternate energy source
- The analysis of Total Energy/Selective Energy (TE/SE) systems

Tables 1 and 2 present information pertaining to the physical descriptions and energy consumption of 43 typical buildings used to

verify historical energy consumption in the development of the basewide energy use model. This model was then utilized as the foundation for energy conservation project analyses and recommendations. Table 3 summarizes the daily personnel occupancy for each typical building. Tables 1, 2 and 3 also provide information which may be used to estimate source energy consumption for similar buildings within the designated groupings (see Appendix A for all tables referenced in this report). The estimated annual source energy consumption for all building types contributing to the basewide annual total of 3,787,735 mega-Btu, consumed during base year 1978, is shown on Figure 1.

Table 4 indicates the annual source energy consumed by each of the significant building groups used in our basewide energy model. Since Fort Campbell has experienced major expansion in its housing of families and troops, our model was compared to fiscal year 1978. This housing expansion has been incorporated into the building list. The building list was then used to develop a basewide model within 10 percent of the FY 78 historical source energy consumption shown below.

	Yearly Source Energy Consumption in Btu x 10^6
Electricity	2,106,125
Natural Gas	1,311,034
Propane Gas	9,880
Fuel Oil No. 2	72,468
Fuel Oil No. 5	288,228
TOTAL	3,787,735



BASEWIDE CONSUMPTION FY'78

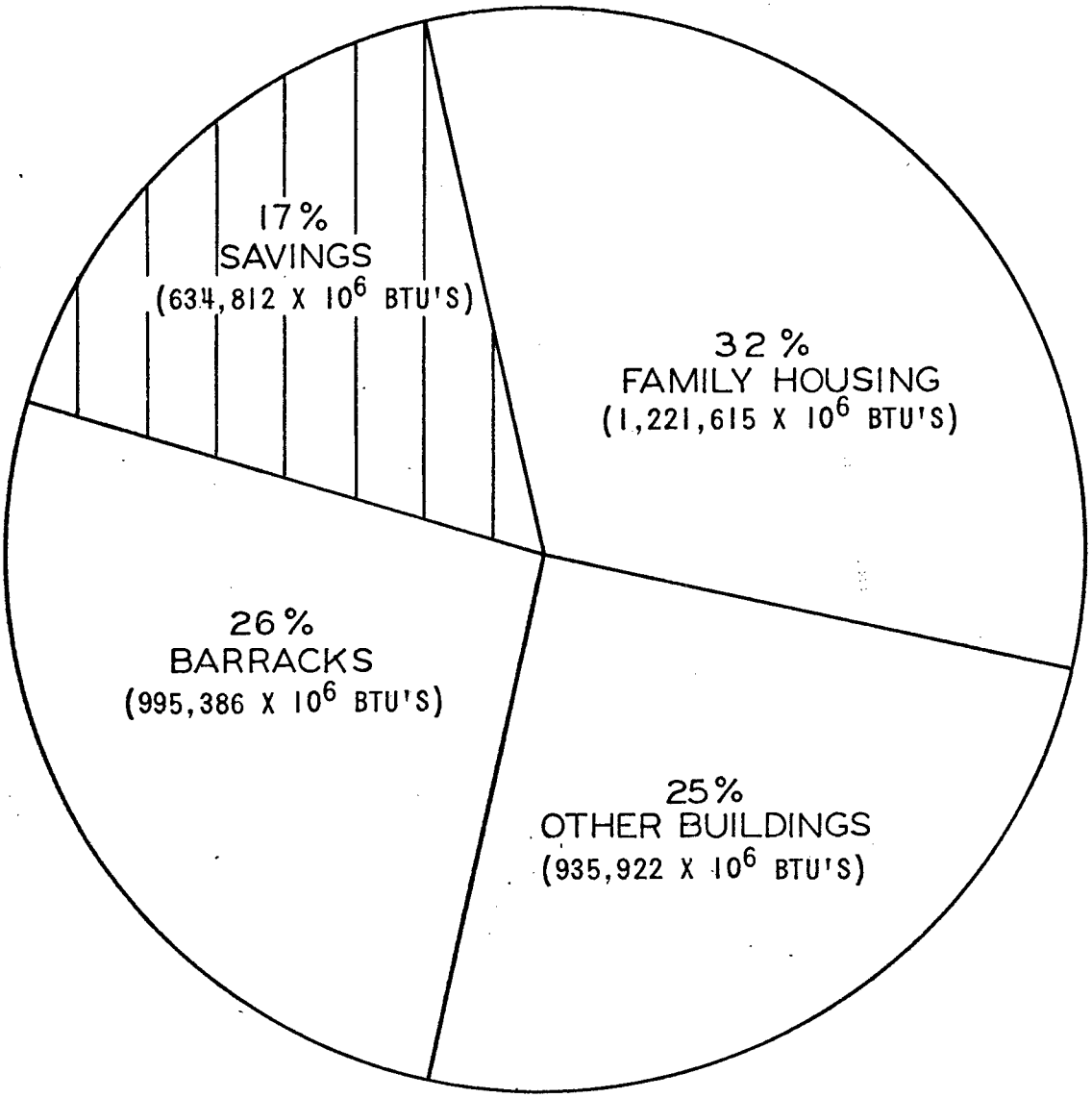
(3,787,735 X 10^6 BTU'S)

FIGURE 1

The total estimated source energy savings due to implementation of all feasible energy conservation projects developed within the scope of this study is 634,812 mega-Btu/year. These projects consisted of various mechanical and electrical system modifications. Refer to Appendix B of this summary for lists of all projects investigated. The lists also provide comments that explain briefly Black & Veatch's action or recommendation. It should be noted that the installation has undertaken implementation of projects recommended by others. Further description of these projects is listed in the report, Total Energy, Selective Energy, and Central Boiler Plants.

Table 5 lists the project number, percent of basewide reduction, and the source energy savings for the indicated building types. Figure 2 illustrates the combined effect of the recommended energy saving improvements, as compared to FY 78 source energy expenditure. Our estimates indicate a savings of approximately 17 percent over the base year (1978). For the source energy consumption of FY's 75 through 77, refer to the Energy Use Survey. Figure 3 illustrates the relative percent reduction for significant building groups comprising the 634,812 mega-Btu/year.

A detailed analysis of the projects listed in Table 5 is included in the following reports. Further explanation of the historical energy consumption, basewide energy model, and energy conservation analysis, can be found in the Energy Use Survey. The reduction of Fort Campbell's dependence on nonrenewable energy sources by utilizing solar energy, a



BASEWIDE CONSUMPTION
AFTER
ENERGY CONSERVATION PROJECTS

(3,152,923 X 10^6 BTU'S)

FIGURE 2

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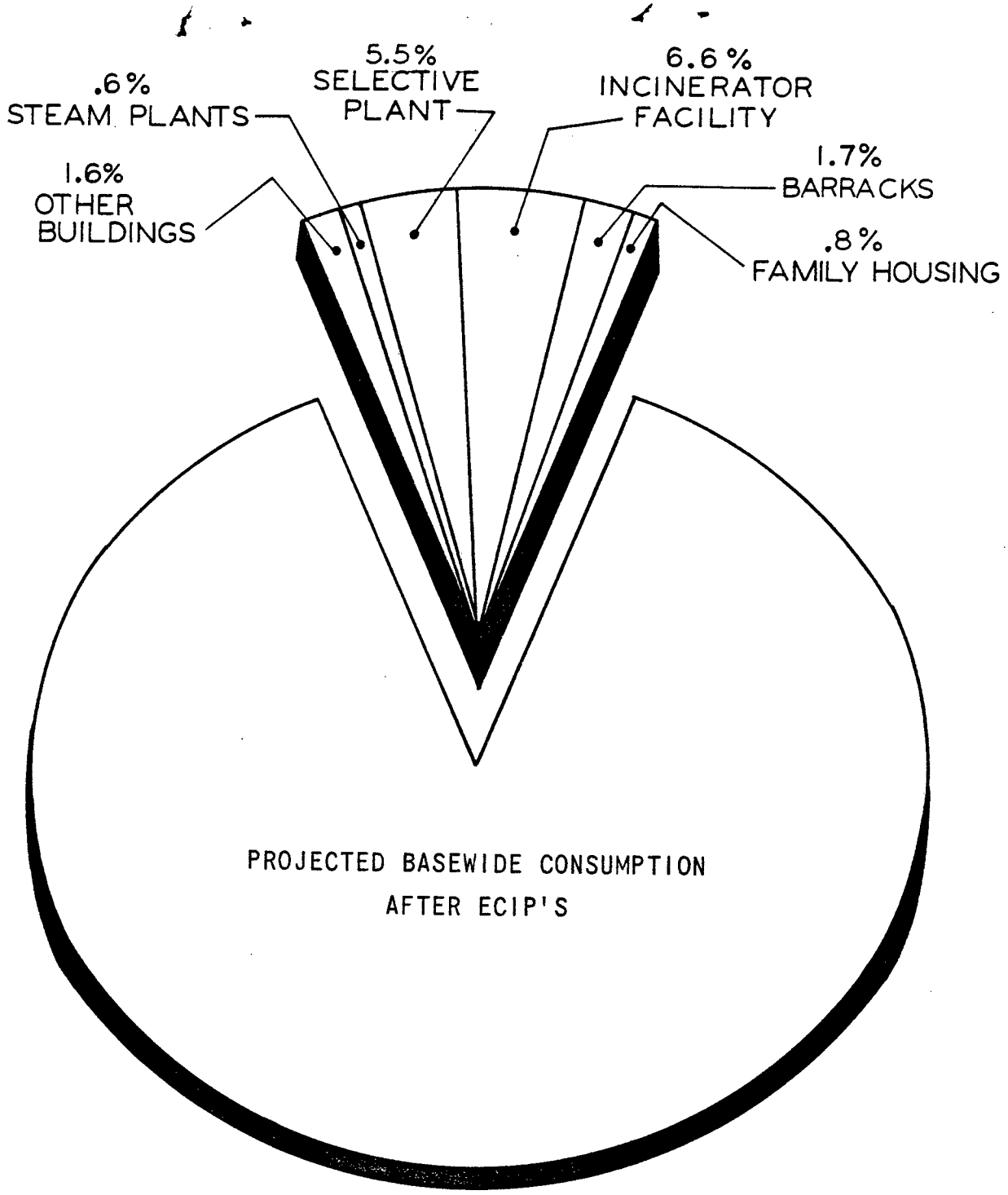


ALLOCATION OF
ENERGY CONSERVATION PROJECT'S
SAVINGS
FOR SIGNIFICANT BUILDING GROUPS

FIGURE 3

renewable energy source, indicates a total savings of 17,176 mega-Btu/year. Nine concepts were evaluated, resulting in the recommendation of Project Nos. 418 and 421 which are presented in the Solar Energy Applications and Evaluations. The report on Energy Monitoring and Control Systems (EMCS), recommends the installation of a minicomputer-based EMCS center. This system would enable the installation to reduce its energy consumption by utilizing various computer initiated energy reducing applications programs. With the addition of an FM radio system under the control of the minicomputer, the entire EMCS project would save 132,718 mega-Btu/year. Additional information is provided in the EMCS report. The investigation of solid waste for reducing source energy consumption at Fort Campbell resulted in the development of Project No. 416. This project recommends the installation of two solid waste-burning incinerator facilities to provide steam to the existing steam distribution systems. The proposed plants would enable the installation to supplement the Central Energy Facility No. 3902 and Heating Plant No. 7008, thereby reducing fuel oil and electric consumption totalling 248,028 mega-Btu/year. The details and descriptions of the systems analyzed can be found in the report, Total Energy, Selective Energy, and Central Boiler Plants.

The installation of a coal-burning Selective Energy plant has been recommended for Fort Campbell. This plant would supply steam to an expanded steam distribution system while generating 36 percent of the installation's total electric power requirements. A basewide source

energy savings of 5 percent could be realized with a reduction of 45 percent in natural gas and fuel oil consumption. Detailed descriptions of the TE/SE systems analyzed are included in the Total Energy, Selective Energy, and Central Boiler Plants report.

Table 6 was developed to give a prioritized schedule, in order of fiscal year, for implementing the recommended energy conservation projects. Figure 4 was ultimately devised to illustrate Fort Campbell's projected source energy use through 1987. The figure includes both the effect of the source energy reduction due to the implementation of the recommended projects by fiscal year and the energy increase based on projected population figures found in the Energy Use Survey. Figure 5 indicates the impact of increasing energy costs and the reduction of those costs after the implementation of projects listed in Table 6. The energy costs were escalated using the rates supplied by the Office of the Chief of Engineers in the volume entitled Energy Conservation Investment Program Guidance.

PROJECTED ENERGY CONSUMPTION - FORT CAMPBELL, KENTUCKY

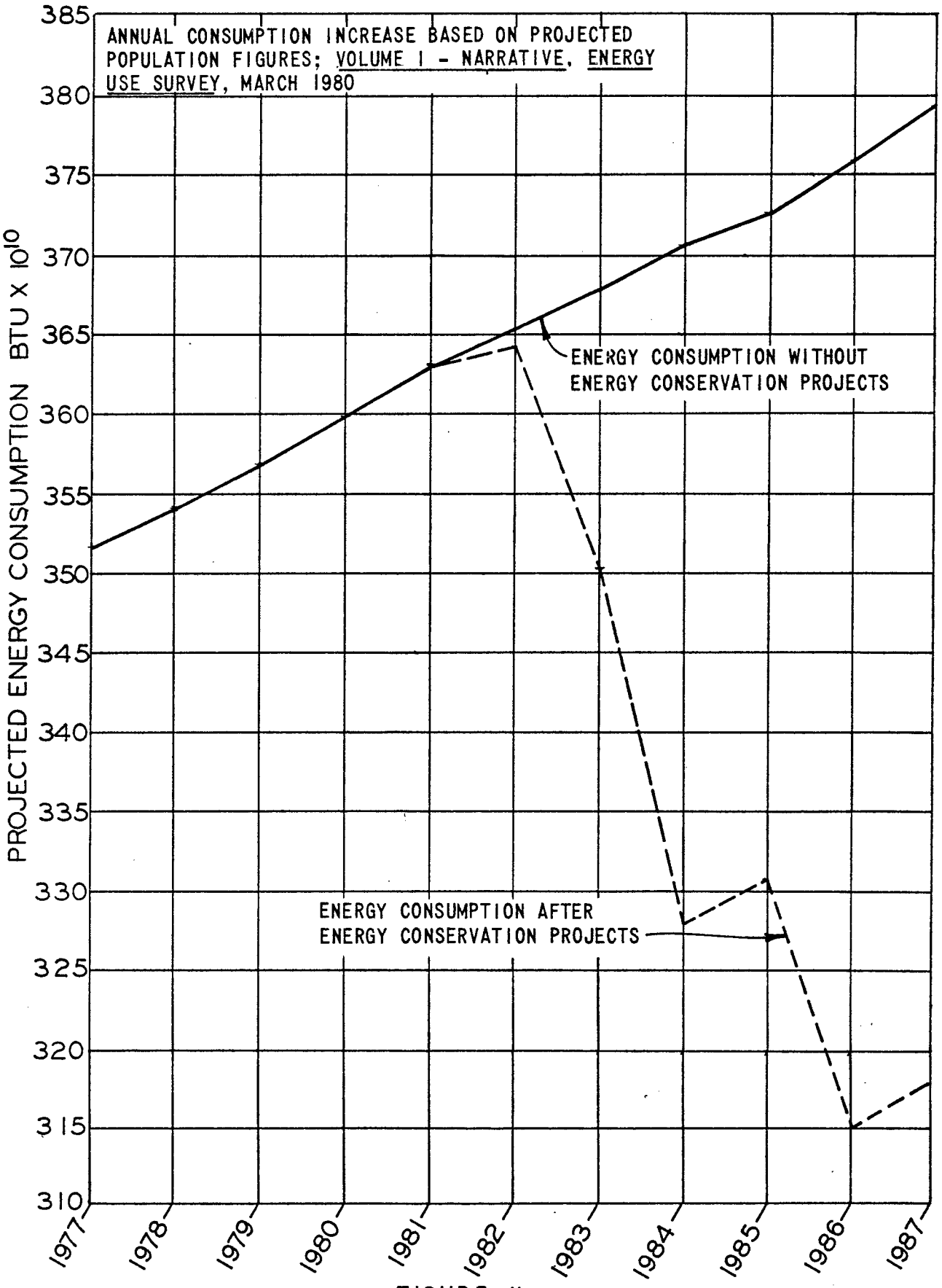
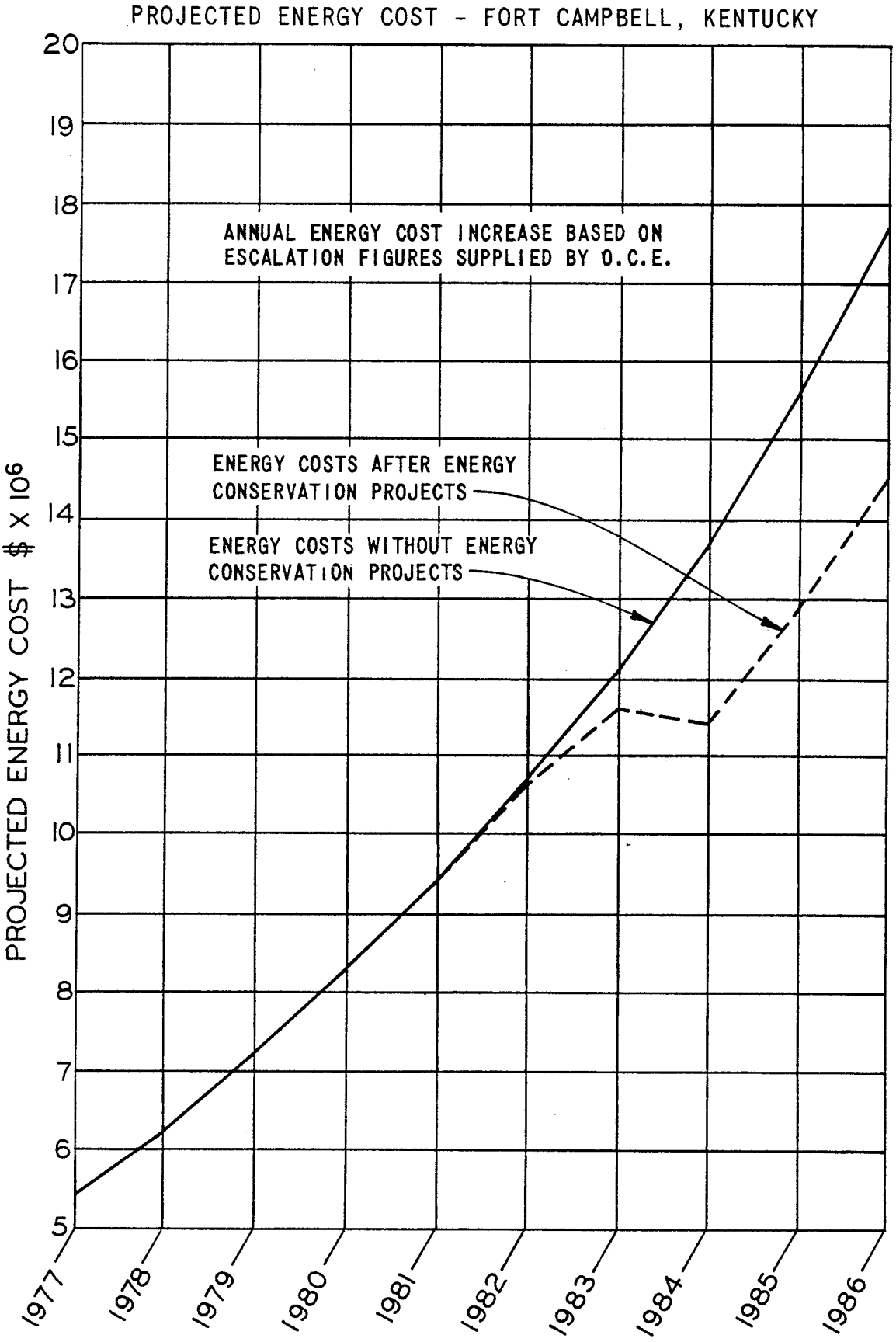


FIGURE 4


PROJECTED ENERGY COST - FORT CAMPBELL, KENTUCKY
ANNUAL ENERGY COST INCREASE BASED ON ESCALATION FIGURES SUPPLIED BY O.C.E.
ENERGY COSTS AFTER ENERGY CONSERVATION PROJECTS
ENERGY COSTS WITHOUT ENERGY CONSERVATION PROJECTS
PROJECTED ENERGY COST $ X 10^6
20
19
18
17
16
15
14
13
12
11
10
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8
7
6
5
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

FIGURE 5

APPENDIX A

TABLES

TABLE I
TYPICAL BUILDING CONSTRUCTION DATA
FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	NO. FLS	CONSTRUCTION					"U" VALUES					WINDOW SQ. FT.	AREA (FT.^{2})	COOLING		HEATING		PEAK TRNS LOAD MBH		DOMESTIC HOT WATER	
				ROOF	WALL	FLOOR	WINDOW	DOOR	ROOF	WALL	FLOOR	WINDOW	DOOR			SYSTEM	CAP. (TONS)	SYSTEM	FUEL	GAIN	LOSS	CAP. (G)	FUEL
A-1	6914	OFFICE	1	BUILT-UP	CMU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.07	.36	—	1.13 1.06	.55	1142	3660	WINDOW UNITS	3	B.P. 7008	HOT H_2O	59.1	187.2	30	ELEC.
A-2	5115	MOTOR REPAIR OFFICE	1	BUILT-UP	ASBESTOS WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.85	.31	—	1.13 1.06	.47 .49	177	3072	WINDOW UNITS	3	UNIT HTRS.	GAS	13.8	188.8	42	ELEC.
A-3	7258	OFFICE	2	BUILT-UP	CMU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.06	.47	—	1.13 1.06	.55	599	6560	SPLIT SYSTEM	20	HOT H_2O BOILER	GAS	52.8	164.2	20	ELEC.
B-1	6709	BARRACKS WITH MESS	3	BUILT-UP	CMU	TILE, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.13	.58	1.13 1.06	.49 .47	5843	39722	ABSORPT. CHILLER	80	B.P. 6711	STEAM	156.6	681.6	950	STEAM
B-2	7120	BARRACKS	3	BUILT-UP	CONC. BLOCK	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.18	.37	—	1.13 1.06	.55	2712	25200	PKG.	46	B.P. 7106	STEAM	183.9	477.1	575	STEAM
B-3	1582	BACHELOR OFFICER'S QTRS.	2	ASPHALT SHINGLES	WOOD SIDING & STUCCO	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.05	.06 .13	—	1.13 1.06	.49 .47	1008	8740	SPLIT SYSTEM	17	FURNACE	GAS/ OIL	31.2	113.7	100	GAS/ OIL
B-4	2170	BARRACKS	2	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, OPEN CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.32	.32	.46	1.13 1.06	.49 .47	404	5310	NONE	—	FURNACE	GAS	—	206.5	100	GAS
C-1	6990	GYMNASIUM	1	BUILT-UP	CMU	SLAB ON GRADE	SINGLE CLEAR GLASS	GLASS, METAL	.07	.51	—	1.13 1.06	.55	1496	23229	PKG. & SPLIT SYSTEM	26	BOILER	GAS	90.5	608.7	250	GAS
C-2	3109	THEATER	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, OPEN CRAWL SPACE	SINGLE CLEAR GLASS	METAL	.32	.32	.46	1.13 1.06	.55	431	8563	SPLIT SYSTEM	13	FURNACE	GAS	104.7	294.9	—	NONE
C-3	2607	CHAPEL	1	ASPHALT SHINGLES	CLAPBOARD WOOD FRAME	T & G, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.34	.26	.19	1.13 1.06	.49 .47	503	3765	NONE	—	UNIT HTR. RADIATOR	GAS	—	125.5	10	GAS
C-4	5702	PRATT MUSEUM	2	BUILT-UP	METAL SIDING	SLAB ON GRADE	NONE	METAL	.07	.06	—	—	.55	NONE	14000	WATER COOLED	90	HOT H_2O BOILER	GAS	35.5	127.8	80	ELEC.
C-5	6722	POST EXCHANGE	1	BUILT-UP	CONC. BLOCK	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.18	.53	—	1.13 1.06	.55	491	3867	WATER COOLED	15	BOILER	GAS	35.7	160.5	140	STEAM
C-6	2575	FIRE STATION	1	BUILT-UP	CMU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.13	.31	—	1.13 1.06	.55	719	7557	WIN. U. & PKG.	9	BOILER	GAS	30.1	163.5	80	ELEC.
D-1	2440	NCO MESS	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.05	.32	.38	1.13 1.06	.49 .47	370	2200	NONE	—	UNIT HTRS.	GAS	—	66.1	100	GAS
E-1	2442	CLASSROOM	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.05	.32	.38	1.13 1.06	.49 .47	370	2200	NONE	—	UNIT HTRS.	GAS	—	75.5	100	GAS
E-2	2912	CLASSROOM	1	METAL	METAL	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.15	.27	—	1.13 1.06	.55	27	3500	NONE	—	FURNACE	GAS	—	95.3	30	GAS
F-1	4368	DUPLEX FAMILY HOUSING	2	ASPHALT SHINGLES	BRICK & ALUMINUM	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.06	.08	—	1.13 1.06	.49 .47	386	3900	HEAT PUMPS	283	HEAT PUMPS	ELEC.	14.6	53.0	40	ELEC.
F-2	402	DUPLEX FAMILY HOUSING	1	ASPHALT SHINGLES	BRICK & WOOD SIDING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.06	.17 .19	—	1.13 1.06	.49 .47	226	2684	PKG.	283	FURNACE	GAS	21.9	56.1	40	GAS
F-3	4848	MULTI-FAMILY HOUSING	2	ASPHALT SHINGLES	BRICK WOOD FRAME	T & G, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.22	.30	1.13 1.06	.49 .47	1428	11304	WINDOW UNIT	1	UNIT HTR.	ELEC.	22.2	220.7	40	ELEC.
F-4	465	SINGLE FAMILY HOUSING	1	ASPHALT SHINGLES	BRICK, WOOD FRAME	OAK, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.08	.20	1.13 1.06	.49 .47	307	1584	WINDOW UNIT	1	CENTRAL HTR.	GAS	4.3	36.6	80	ELEC.
F-5	3027	MULTI-FAMILY HOUSING	2	BUILT-UP	BRICK & SHEATHING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.07	.08	—	1.13 1.06	.49 .47	1633	10296	WINDOW UNIT	1	CENTRAL HTR.	GAS	18.1	177.1	40	ELEC.
F-6	7370	MULTI-FAMILY HOUSING	2	BUILT-UP	BRICK & WOOD SIDING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.05	.20 .22	—	1.13 1.06	.49 .47	1867	10496	REMOTE AIR COOLED	26	CENTRAL HTR.	GAS	59.9	200.7	40	ELEC.
L-1	860	LAUNDRY	1	ASPHALT SHINGLES	CLAPBOARD WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.33	.26	—	1.13 1.06	.49 .47	36	55558	WINDOW UNIT	1.5	NONE	—	9.59	—	N/A	—
M-1	125	HOSPITAL	2	ASPHALT SHINGLES	BRICK	T & G, CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.33	.26	.30	1.13 1.06	.49 .47	3246	16768	CENTRAL & WIN.	28	B.P. 157	STEAM	167.4	524.4	200	GAS
MP-1	127	HOSPITAL	2	ASPHALT SHINGLES	BRICK	T & G, CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.33	.26	.30	1.13 1.06	.49 .47	3246	16768	NONE	—	B.P. 157	STEAM	—	595.0	200	GAS
M-P	7297	HELICOPTER HANGER	2	BUILT-UP	CMU, METAL	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.18 .05	.51 .13	—	1.13 1.06	.55	400	48564	AIR COOLED CHILLER	30	B.P. 7294	STEAM	187.0	448.5	100	ELEC.
P-1	749	MOTOR REPAIR	1	MINERAL SURFACE	CLAPBOARD, WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.32	.36	—	1.13 1.06	.55	456	3108	NONE	—	BOILER	COAL	—	157.5	40	ELEC.
RM-1	6256	MOTOR REPAIR SHOP	1	BUILT-UP	CONCRETE	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.13	.67	—	1.13 1.06	.55	1326	4960	NONE	—	B.P. 6256	GAS	—	192.0	40	GAS
RM-2	5852	REPAIR & MAINTENANCE	1	MINERAL SURFACE	CLAPBOARD T & G SIDING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.32	.36 .44	—	1.13 1.06	.49 .47	48	2312	NONE	—	BOILER	COAL	—	35.9	40	GAS

TABLE I (CONT'D)
TYPICAL BUILDING CONSTRUCTION DATA
FORT CAMPBELL

GROUP NO.	BLDG	BUILDING DESCRIPTION	NO. FLS	CONSTRUCTION					"U" VALUES					WINDOW SQ. FT.	AREA (FT.^{2})	COOLING		HEATING		PEAK LOAD TRNS MBH		DOMESTIC HOT WATER	
				ROOF	WALL	FLOOR	WINDOW	DOOR	ROOF	WALL	FLOOR	WINDOW	DOOR			SYSTEM	CAP. (TONS)	SYSTEM	FUEL	GAIN	LOSS	CAP. (G)	FUEL
T-1	7851	RECEIVER BUILDING	1	BUILT-UP	CONCRETE BLOCK	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.12	.15	—	1.13 1.06	.55	125	1089	NONE	—	BOILER	GAS	—	24.8	40	GAS
T-2	7238	COMMUNICATION	1	BUILT-UP	CMU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.12	.15	—	1.13 1.06	.55	133	1392	SPLIT SYSTEM	8	BOILER	OIL	6.0	31.0	10	ELEC.
W-1	806	WAREHOUSE	1	ASPHALT SHINGLES	CLAPBOARD, WOOD FRAME	WOOD, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	METAL WOOD	.48	.36	.38	1.13 1.06	.55 .49	70	9000	NONE	—	STEAM UNIT HTR.	COAL	—	226.0	40	GAS
W-2	854	WAREHOUSE	1	ASPHALT SHINGLES	CLAPBOARD, T & G SIDING	CONCRETE, CRAWL SPACE	SINGLE CLEAR GLASS	T & G	.52	.36	.52	1.13 1.06	.56	240	1350	NONE	—	STEAM UNIT HTR.	COAL	—	66.2	40	GAS
W-3	160	MEDICAL WAREHOUSE	1	ASPHALT SHINGLES	BRICK WOOD FRAME	T & G, CLOSED CRAWL SPACE	SINGLE CLEAR GLASS	WOOD	.52	.20 .28	.30	1.13 1.06	.49 .47	1026	26673	WINDOW UNITS	13	B.P. 157	STEAM	42.5	461.9	40	STEAM
L-2	2842	PRESSING PLANT	1	STEEL	CONCRETE	CONCRETE	SINGLE CLEAR GLASS	METAL	(NO HTG. OR CLG., NO "U" VALUES NECESSARY)						35520	NONE	—	NONE	—	—	—	—	N/A	—
U-1	7635	SEWAGE TREATMENT	←					NOT APPLICABLE →						→	1260	NONE	—	UNIT HTR.	ELEC.	—	29.3		NONE
U-2	1746	WATER TREATMENT	←					NOT APPLICABLE →						→	10276	NONE	—	NONE	—	—	—	40	ELEC.
U-3	7292	PUMPHOUSE	←					NOT APPLICABLE →						→	1007	NONE	—	NONE	—	—	—	—	NONE
U-4	7008	BOILER PLANT	←					NOT APPLICABLE →						→	2828	WINDOW	2	UNIT HTR.	STEAM	12.5	8	40	GAS
U-5	1137	MACHINE SHOP	←					NOT APPLICABLE →						→	120	NONE	—	NONE	—	—	—	—	NONE
Z	—	ELECT. USE ONLY	(INCLUDES OUTDOOR LIGHTS AND ELECTRIC AUXILIARIES) ←					NOT APPLICABLE →						→		NONE	—	NONE	—	—	—	—	NONE
V	—	REAL ESTATE	←					NOT APPLICABLE →															→
X	—	BUILDINGS USING NO UTILITIES ←						NOT APPLICABLE →															→

TABLE 2

TYPICAL BUILDING ENERGY CONSUMPTION DATA

FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	ANNUAL ENER. SOURCE CONSUMPTION BTU x 10^6			ELEC'L ENER. CONSUMPTION		BTU x 10^3 / FT^2
			FUEL	ELEC.	TOTAL	KW PEAK	KWH/YR	
A-1	6914	OFFICE	868	415	1283	36	35750	350.5
A-2	5115	MOTOR REPAIR OFFICE	630	265	895	16	22860	291.3
A-3	7258	OFFICE	669	1850	2519	72	159490	384.0
B-1	6709	BARRACKS WITH MESS	10101	4675	14776	94	403048	372.0
B-2	7120	BARRACKS	2704	5423	8127	160	467481	322.5
B-3	1582	BACHELOR OFFICER'S QTRS.	1032	1873	2905	48	161460	332.4
B-4	2170	BARRACKS	1347	66	1413	2	5660	266.1
C-1	6990	GYMNASIUM	3953	2540	6493	97	218930	279.5
C-2	3109	THEATER	1137	401	1538	52	34560	337.1
C-3	2607	CHAPEL	513	384	897	12	33130	238.2
C-4	5702	PRATT MUSEUM	1768	907	2675	79	78160	191.1
C-5	6722	POST EXCHANGE	972	1947	2919	67	167840	754.8
C-6	2575	FIRE STATION	918	947	1865	34	81610	246.8
D-1	2440	NCO MESS	625	134	759	3	11570	345.0
E-1	2442	CLASSROOM	514	147	661	6	12670	300.5
E-2	2912	CLASSROOM	441	325	766	11	27990	218.9
F-1	4364	DUPLEX FAMILY HOUSING	0	787	787	33	67870	201.8
F-2	402	DUPLEX FAMILY HOUSING	417	197	614	11	16990	228.8
F-3	4848	MULTI-FAMILY HOUSING	0	4444	4444	145	383130	393.1
F-4	465	SINGLE FAMILY HOUSING	210	266	476	10	22900	300.5
F-5	3027	MULTI-FAMILY HOUSING	795	2061	2856	69	177700	277.4
F-6	7370	MULTI-FAMILY HOUSING	916	2316	3232	144	199680	307.9
L-1	860	LAUNDRY	66960	13227	80187	264	1140240	1443.3
M-1	125	HOSPITAL	3665	2163	5828	112	186460	347.6
MP-1	127	HOSPITAL	5400	1482	6882	18	127820	410.4
M-P	7297	HELICOPTER HANGER	1239	7971	9210	323	687160	189.6
P-1	749	MOTOR REPAIR	238	212	450	9	18250	144.8
RM-1	6256	MOTOR REPAIR SHOP	249	441	690	17	38030	139.1
RM-2	5852	REPAIR & MAINTENANCE	282	34	316	1	2960	136.7

TABLE 2 (CONT'D)
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT CAMPBELL

GROUP NO.	BLDG	BUILDING DESCRIPTION	ANNUAL ENER. SOURCE CONSUMPTION BTU x 10⁶			ELEC'L ENER. CONSUMPTION		BTU x 10³ / FT²
			FUEL	ELEC.	TOTAL	KW PEAK	KWH/YR	
T-1	7851	RECEIVER BUILDING	204	392	596	9	33800	547.3
T-2	7238	COMMUNICATION	155	884	1039	24	76170	746.4
W-1	806	WAREHOUSE	1282	779	2061	17	67160	229.0
W-2	854	WAREHOUSE	1843	763	2606	17	65810	1930.4
W-3	160	MEDICAL WAREHOUSE	1712	360	2072	33	31070	77.7
L-2	2842	PRESSING PLANT	1113	3764	4877	106	324500	137.3
U-1	7635	SEWAGE TREATMENT	0	2086	2086	71	179980	1655.6
U-2	1746	WATER TREATMENT	0	46940	46940	581	4046570	4567.9
U-3	7292	PUMPHOUSE	0	30039	30039	338	2589560	29830.2
U-4	7008	BOILER PLANT	52	222	274	5	19110	96.9
U-5	1137	MACHINE SHOP	0	6917	6917	690	596330	57641.7
Z	—	ELECT. USE ONLY	0	112361	112361	N/A	9686325	N/A
V	—	REAL ESTATE	←		N/A			→
X	—	NO UTILITIES	←		N/A			→

TABLE 3

BUILDING OCCUPANCY

FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	NORMAL PEAK POPULATION	OCCUPANCY
A-1	6914	OFFICE	20	WEEKDAYS - 6:30 A.M. TO 6:00 P.M.; 3 PEOPLE AT NIGHT
A-2	5115	MOTOR REPAIR OFFICE	11	WEEKDAYS - 7:30 A.M. TO 4:00 P.M.
A-3	7258	OFFICE	35	OPEN 24 HOURS - 35 PEOPLE FROM 7:00 A.M. TO 6:00 P.M.; 2 PEOPLE AT NIGHT
B-1	6709	BARRACKS WITH MESS	333	BARRACKS OPEN 24 HOURS MESS OPEN 6:30 A.M. TO 8:00 P.M.; KITCHEN PERSONNEL START AT 4:00 A.M.
B-2	7120	BARRACKS	144	OPEN 24 HOURS
B-3	1582	BACHELOR OFFICERS' QTRS.	24	OPEN 24 HOURS
B-4	2170	BARRACKS	28	OPEN 24 HOURS
C-1	6990	GYMNASIUM	1000	WEEKDAYS - 9:00 A.M. TO 9:00 P.M. WEEKENDS - 12:00 NOON TO 9:00 P.M.
C-2	3109	THEATER	176	WEEKDAYS - 1:00 P.M. TO 10:00 P.M. OCCASIONALLY ON WEEKENDS
C-3	2607	CHAPEL	300	7 DAYS A WEEK, 5 PERSONS AVERAGE, 7:00 A.M. TO 10:00 P.M.; TUESDAY & THURSDAY - 40 PERSONS IN EVENING; SUNDAY - 300 PERSONS, 9:45 A.M. TO 12:00 NOON
C-4	5702	PRATT MUSEUM	25	WEEKDAYS - 12:30 P.M. TO 4:30 P.M. WEEKENDS - 1:00 P.M. TO 4:30 P.M.
C-5	6722	POST EXCHANGE	100	WEEKDAYS - 11:00 A.M. TO 6:00 P.M.
C-6	2575	FIRE STATION	12	OPEN 24 HOURS
D-1	2440	NCO MESS	80	WEEKDAYS - 5:00 A.M. TO 7:00 P.M.
E-1	2442	CLASSROOM	100	WEEKDAYS - 7:00 A.M. TO 6:00 P.M.
E-2	2912	CLASSROOM	125	TUESDAY TO FRIDAY - 8:00 A.M. TO 11:30 A.M.
F-1	4364	DUPLEX FAMILY HOUSING	8	OPEN 24 HOURS
F-2	402	DUPLEX FAMILY HOUSING	8	OPEN 24 HOURS
F-3	4848	FAMILY HOUSING	48	OPEN 24 HOURS
F-4	465	FAMILY HOUSING	4	OPEN 24 HOURS
F-5	3027	FAMILY HOUSING	32	OPEN 24 HOURS
F-6	7370	MULTI-FAMILY HOUSING	32	OPEN 24 HOURS
L-1	860	LAUNDRY	112	WEEKDAYS - 7:00 A.M. TO 3:00 P.M.
M-1	125	HOSPITAL	120	OPEN 24 HOURS
M-2	127	HOSPITAL	120	OPEN 24 HOURS
MP	7297	HELICOPTER HANGER	150	WEEKDAYS - 7:00 A.M. TO 6:00 P.M.
P-1	749	MOTOR REPAIR	10	WEEKDAYS - 7:30 A.M. TO 4:00 P.M.
RM-1	6256	MOTOR REPAIR SHOP	30	WEEKDAYS - 7:30 A.M. TO 4:30 P.M.
RM-2	5852	REPAIR & MAINTENANCE	25	WEEKDAYS - 6:00 A.M. TO 4:30 P.M.
T-1	7851	RECEIVER BUILDING	4	OPEN 24 HOURS
T-2	7238	COMMUNICATION	5	OPEN 24 HOURS - 5 PERSONS FROM 7:00 A.M. TO 4:00 P.M., 2 PERSONS FROM 4:00 P.M. TO 7:00 A.M.
W-1	806	WAREHOUSE	10	WEEKDAYS - 8:00 A.M. TO 3:30 P.M.
W-2	854	WAREHOUSE	N/A	ONLY WHEN SOMETHING IS BEING STORED OR REMOVED
W-3	160	MEDICAL WAREHOUSE	21	WEEKDAYS - 7:30 A.M. TO 4:30 P.M.
L-2	2842	PRESSING PLANT	45	7 DAYS A WEEK - 7:00 A.M. TO 5:00 P.M.
U-1	7635	SEWAGE TREATMENT	2	OPEN 24 HOURS - 7 DAYS A WEEK
U-2	1746	WATER TREATMENT	10	OPEN 24 HOURS - 7 DAYS A WEEK

TABLE 3 (CONT'D)

BUILDING OCCUPANCY

FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	NORMAL PEAK POPULATION	OCCUPANCY
U-3	7292	PUMPHOUSE	——	——
U-4	7008	BOILER PLANT	1	OPEN 24 HOURS - 7 DAYS A WEEK
U-5	1137	MACHINE SHOP	6	7:30 A.M. TO 4:30 P.M. - 5 DAYS A WEEK

TABLE 4

Building Group Source Energy Consumption

Group	Description	Group Sq. Ft.	Total Source Consumption $Btu's \times 10^6$
A	Administrative	1,137,775	349,534
B	Barracks	3,967,825	1,179,135
C	Community Service	1,135,297	404,776
D	Dining	92,649	31,228
E	Classroom	190,965	51,915
F	Family Housing	5,718,653	1,328,611
L	Laundry	91,078	82,855
MP	Maintenance and Production	464,460	76,588
M	Medical	352,066	128,149
P	Maintenance	219,531	29,816
RM	Maintenance and Repair	716,075	94,704
T	Communications	53,730	33,912
U-1	Sewage Treatment	1,371	5,899
U-2	Water Treatment	10,276	91,068
U-3	Pump Houses	4,663	26,134
U-4	Boiler Plants	18,183	1,689
U-5	Unheated Buildings w/Electricity	18,980	6,018
W	Warehouses	931,999	140,479
Z	Electric Only (includes outdoor lights)	496,999	97,754

ENERGY CONSERVATION PROJECTS
SOURCE ENERGY SAVINGS

BUILDING TYPE	ENERGY SAVINGS BTU x 1,000,000	% BASEWIDE REDUCTION FY 78	PROJECT NO.
FAMILY HOUSING	15,600 12,738 28,338	.41 .34 .75	T-418 288
BARRACKS	65,180	1.72	288
INCINERATOR FACILITY	248,028	6.55	T-416
STEAM PLANTS	24,159	.64	T-420
SELECTIVE ENERGY PLANT	208,000	5.49	
OTHER BUILDINGS AFFECTED BY ECIP'S	1,576 54,800 4,731 61,107	.04 1.45 .12 1.61	T-421 288 T-398
TOTAL	634,812	16.76	

TABLE 5

ENERGY CONSERVATION PROJECTS DEVELOPED SCHEDULE - FT. CAMPBELL, KENTUCKY

PROJECT TITLE	PROJECT NUMBER	RECOMMENDED FISCAL YEAR	COST $ x 1000	E/C RATIO	ENERGY SAVINGS BTU x 1,000,000	YEARS PAYBACK	B/C RATIO
POWER FACTOR IMPROVEMENT (BASEWIDE)	T-398	1981	136	34.87	4,731	13.6	1.26
TOTAL			136		4,731		
SOLID WASTE BURNING INCINERATOR FACILITIES	T-416	1982	7,324	33.9	248,028	12.4	2.09
SUPPLEMENTAL SOLAR DOMESTIC HOT WATER SYSTEMS	T-418	1982	645	24.2	15,600	15.3	1.10
STEAM PLANT MODIFICATIONS	T-420	1982	501	48.3	24,159	6.1	3.3
SOLAR HEATING OF INDOOR SWIMMING POOL AND SHOWER WATER	T-421	1982	80	19.6	1,576	9.9	1.91
ENERGY MONITORING AND CONTROL SYSTEM	288	1982	2,825	46.97	132,718	14.72	1.07
TOTAL			11,670		422,081		
SELECTIVE ENERGY PLANT		1983	72,050	N/A	208,000	17.83	1.33
TOTAL					208,000		

TABLE 6

APPENDIX B

POTENTIAL CONSERVATION MEASURES

TABLE OF CONTENTS

POTENTIAL CONSERVATION MEASURES REQUIRING CAPITAL INVESTMENT B-1

POTENTIAL CONSERVATION MEASURES REQUIRING POLICY CHANGES AT INSTALLATION LEVEL B-3

POTENTIAL CONSERVATION MEASURES REQUIRING CAPITAL INVESTMENT

	Project Studied	Comments
1.	Install setback/setup controls.	Good project
2.	Add warmup cycle with fresh air dampers closed where setback/ setup controls are used.	Good project
3.	Replace existing coal boilers with gas/oil conversion kits with modern packaged boilers.	This project does not meet the criteria.
4.	Replace incandescent lighting with higher efficiency lighting systems.	Good project
5.	Replace existing motors with motors of the high efficiency type.	There is an engineering disagreement concerning this project.
6.	Insulate existing steam lines.	This project does not meet the criteria.
7.	Revise existing chilled water/ hot water pumping schemes to more efficient methods.	This project does not meet the criteria.
8.	Install economizer systems for "free cooling" in intermediate seasons.	This project does not meet the criteria in retrofit applications.
9.	Modify multizone systems to include hot/cold deck reset.	Good project
10.	Modify cooling tower systems to cycle fan with load and/or install bypass valving.	Condenser water reset is the best modification.
11.	Install load-shedding system to minimize demand charges.	Good project
12.	Correct power factor.	Good project
13.	Install chilled and hot water reset controls.	Good project

POTENTIAL CONSERVATION MEASURES REQUIRING CAPITAL INVESTMENT
(Continued)

	Project Studied	Comments
14.	Install FM radio control system.	Good project
15.	Upgrade electrical distribution voltage.	This project does not meet the criteria.
16.	Install total or selective energy plants.	Selective energy is cost effective.
17.	Install energy monitoring and control system.	Good project
18.	Install heat reclaim devices on air-cooled condensers.	This is a viable project in messhalls and family housing.
19.	Replace remotely located absorption chillers with more efficient electric-driven chillers.	Good project
20.	Install solid waste-burning boilers.	Good project
21.	Install trailer enclosing devices at loading docks.	This project has limited application.
22.	Install solar energy systems where feasible.	This project has limited application.
23.	Install air-to-air heat reclaim devices in high exhaust areas, such as messhall kitchens.	This project does not meet the criteria.

POTENTIAL CONSERVATION MEASURES REQUIRING POLICY CHANGES
AT INSTALLATION LEVEL

	Project Studied	Comments
1.	Replace domestic water heaters with higher efficiency models as replacement is required.	Good project
2.	Shut down steam branch lines in summer.	Good project
3.	Reduce domestic hot water temperatures from 140 F to 110-120 F.	Good project
4.	Replace electric motors with motors of the high efficiency type on replacement basis.	Good project
5.	Use task lighting.	Good project
6.	Install temporary 4-mil plastic storm windows.	Good project
7.	Shut down HVAC and DHW systems in unoccupied buildings.	Good project
8.	Calk cracks on self-help basis.	Good project
9.	Install high-efficiency transformers on replacement basis.	Good project
10.	Enforce indoor space temperature regulations.	Good project
11.	Repair steam, condensate, chilled water, and HTHW leaks.	Good project
12.	Repair air leakage in ducts.	Good project
13.	Turn pilot lights for heating equipment off for the summer.	Good project
14.	Replace air-conditioning units with high efficiency models as replacement is required.	Good project